

Evaluation of the Performance of a Covered Lagoon for Flushed Dairy Cattle Manure

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Castelanelli Brothers Dairy

- 550 acres
- Located in Lodi, CA
- Milking herd: 1,500 to 1,600
- Dry cows: 400 to 450
- Replacements (> 3 months): 1,200 to 1,400

Housing

- Milking herd & dry cows: Open sided free-stall barns with flushed alleys
- Replacements: Paved lots with free-stalls & flushed alleys
- Unpaved corrals: Dry season access
- Bedding:
 - Milking herd & dry cows: sand
 - Replacements: separated manure coarse solids

Manure Management

- Settling basin for sand removal
- Stationary screen for coarse solids removal
- Covered anaerobic lagoon for manure stabilization and biogas capture (RCM International, Berkeley, CA)
- Two earthen ponds for covered lagoon effluent storage and reuse for flushing
- Milking center wastewater is co-mingled with the flushed manure

Covered Lagoons Details

- Operating volume: 2,520,000 ft³
- Design HRT: 40 days
- Estimated biogas production potential:
60,000 to 130,000 ft³/day
- Estimated electricity generation potential:
90 to 180 kW

Biogas Utilization

- Caterpillar 3406 TA 180kW engine-generator set
- Interconnection with PG&E under a net metering agreement

Performance Parameters

- Physical, chemical, & microbial characteristics
 - Flush water
 - Stationary screen influent
 - Covered lagoon influent
 - Separated solids
- Biogas production & utilization
- Electricity generation

Waste Stabilization

Parameter	Reduction, %
Total solids	67.1
Total volatile solids	62.4
Fixed solids	77.6
Chemical oxygen demand	59.7
Total volatile acids	~100

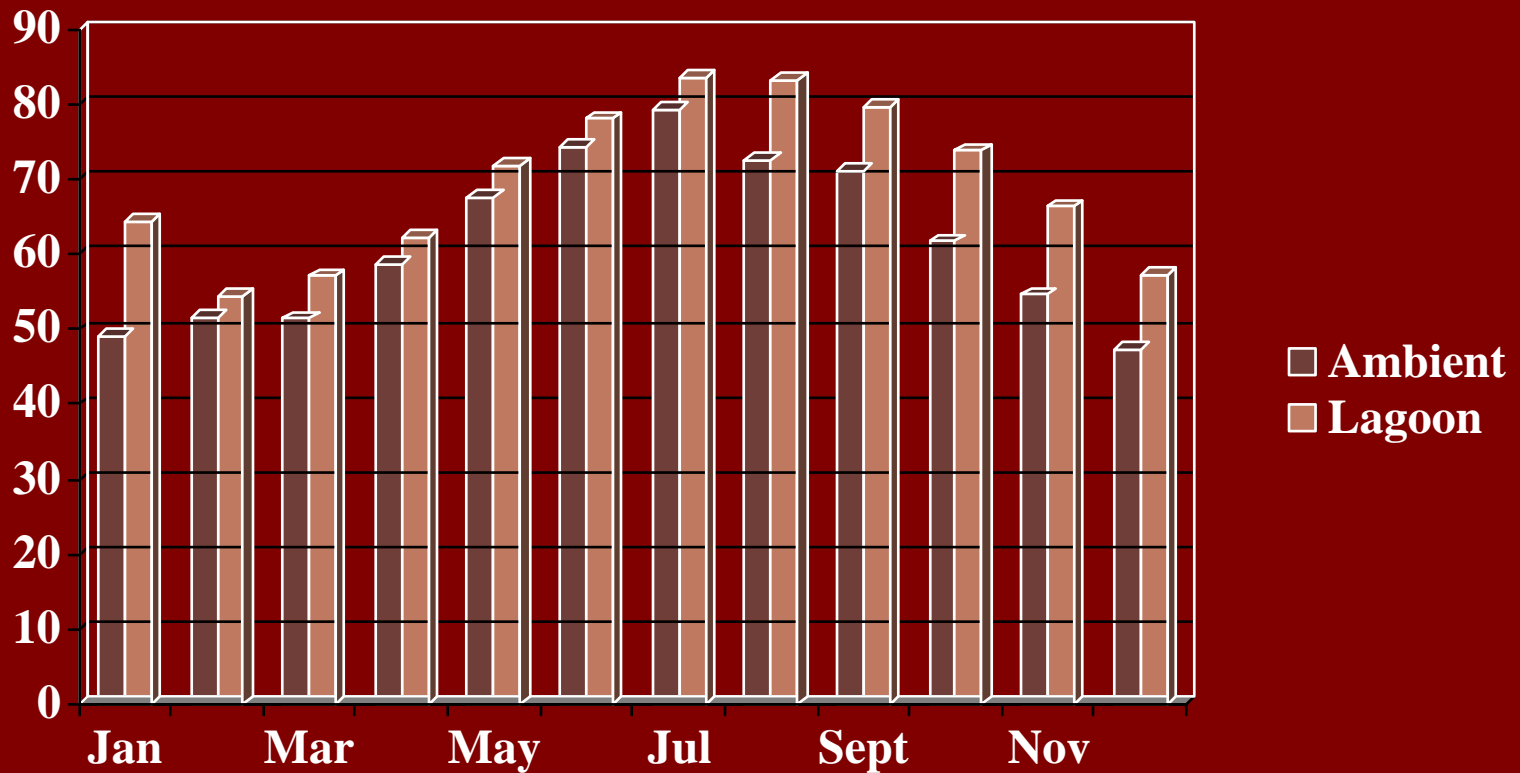
Indicator Organism Reductions, \log_{10} CFU/100 ml

Parameter	Flush water	Lagoon influent	Lagoon effluent
Fecal coliforms	4.79 ^a ±0.97	5.91 ^b ±0.61	4.84 ^a ±0.56
Fecal streptococcus	5.12 ^a ±0.63	5.56 ^b ±0.49	5.00 ^a ±0.64

Biogas Production & Utilization, ft³/day

Production	Utilization	Flared
118,503±11,880	76,076±9,424	42,435±15,199

Covered lagoon versus ambient temperature, °F



Engine-Generator Set Performance

	On-line Efficiency, %	Thermal Conversion Efficiency, %
Mean±Std Dev	90.4±0.14 (9 month—95.9)	27.8±3.6
Range	50.4-100	18.9-33.0

Electricity, kWh

Generated (annual rate)	On-site demand (2005)	Surplus (delivered to PG&E)
1,522,780	903,716	619,064

Economics

	Without income from surplus electricity	With income from surplus electricity
Value of electricity used on-site @ \$0.103/kWh	\$93,083	\$93,083
Revenue from surplus electricity @ \$0.0605/kWh	\$0	\$37,453
Gross annual income	\$93,083	\$130,536
Annual O&M cost @ \$0.02/kWh	\$22,842	\$22,842
Net annual revenue	\$70,241	\$107,694

Economics (continued)

	Simple Payback w/o Interest	Net Income over 20 years
Without income from surplus electricity	~12.6 yr	\$519,783
With income from surplus electricity	~8.2 yr	\$1,270,789

Economics (continued)

	Annual Payment @ 6 %, 20 yr	Net Income Over 20 years
Without income from surplus electricity	\$76,905	(\$133,280)
With income from surplus electricity	\$76,905	\$615,780

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Thank-you!

Questions?